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# evaluation of "PITCH CANKER"

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## in FLORIDA SLASH PINE PLANTATIONS and SEED ORCHARDS

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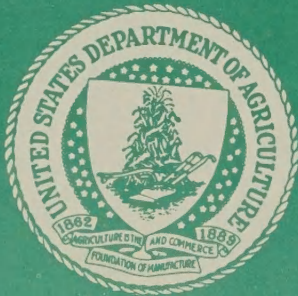
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EVALUATION OF "PITCH CANKER" <sup>1/</sup> IN FLORIDA SLASH PINE PLANTATIONS  
AND SEED ORCHARDS 1976

William R. Phelps and Charles W. Chellman <sup>2/</sup>

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ABSTRACT

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An evaluation of "pitch canker" incidence, severity and impact was made in slash pine plantations and seed orchards. The disease was found in all 67 Florida counties. Disease incidence has greatly intensified and become more widespread since the initial survey was made in 1953. It was most serious in the central and southern counties, especially Volusia, Osceola, Sumter, Lee, Hillsborough, Flagler, and Glades. Incidence was especially high in localized areas ranging to 67 percent in Volusia county. Statewide, disease incidence was 2 percent in trees 5 to 10 years, 5 percent in trees 11 to 16 years, 13 percent in trees 17 to 22 years, 25 percent in trees 23 to 28 years. Incidence was highest and the disease most widespread on flat, sandy, wet, and fertilized sites. Wood fiber loss was 1.4 cords/acre due primarily to growth reduction in diseased trees. Potential losses could be as high as 6.8 cords/acre. Tree mortality was negligible due to the disease, but was 8.5 percent from other causes. Twenty-two of 25 slash pine seed orchards evaluated were found to be infected with "pitch canker". The disease was attacking certain families while others remained free from infection.

INTRODUCTION

Pitch canker, Fusarium lateritium f. pini (Nees.) Hepting, is an intermittently damaging forest disease of southern pines. The disease has been reported occurring from Virginia to southern Florida and westward to Louisiana and Tennessee. It is especially serious on both slash pine varieties (Pinus elliottii, Engelm.) var. elliottii and densa and Virginia pine (P. virginiana Mill.). It also attacks shortleaf (P. echinata Mill.), longleaf (P. palustris Mill.), scotch (P. sylvestris L.), table mountain (P. pungens Lamb.), pitch (P. rigida Mill.), loblolly (P. taeda L.) (2). Isolations were recently made from sand pine (P. clausa Chapm.). <sup>3/</sup> The disease was first observed and described by Hepting and Roth in 1945 on Virginia pine at Bent Creek, North Carolina (6).

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<sup>1/</sup> Results of this evaluation are based on signs and symptoms similar to that of pitch canker caused by Fusarium lateritium f. pini.

<sup>2/</sup> Plant Pathologist, Southeastern Area, U.S. Forest Service, and Entomologist, Florida Division of Forestry. Acknowledgement is made for the field assistance furnished by personnel of the Florida Division of Forestry; the industrial seed orchards; State and Private Forestry, Forest Insect and Disease Management, Dr. D.O. Yandle, biometrician without whose assistance this evaluation could not have been accomplished.

<sup>3/</sup> Personal communication from C.S. Moses.



Symptoms of the disease are easily detected as sunken cankers on the main stem which exude copious amounts of pitch. The wood beneath the canker becomes heavily pitch soaked and is discolored light to dark brown. On slash pine, in addition to typical main stem cankers, terminal and lateral branches are frequently attacked resulting in branch flagging and death of the portion above the cankered area. Cankers on the terminal and lateral branches are usually not sunken, but exude pitch droplets and the wood under the bark is discolored. In many cases the terminal branch dies and secondary lateral branches become dominant causing a crook or a fork in the main stem. Severely attacked trees may die within a year while others suffer varying amounts of growth loss depending on severity of attack. Most trees recover from attack by the fungus (2,8).

There has probably been less research on this disease than any other in the South. The disease is not new to the South and was widespread over the southeast in 1953 when the initial detection survey was made by Hepting and Roth (7). It was found in 5 counties in Virginia, 12 in North Carolina, 2 in Tennessee, 8 in South Carolina, 15 in Georgia, 38 in Florida, 2 in Alabama, and 1 in Mississippi.

Bethune and Hepting (3) appraised pitch canker damage in natural south Florida slash stands (Hendry and Collier Counties) during the period 1955-60. They evaluated sixteen 1/4 acre plots ranging in age from 14 to 21 years. Results showed the number of trees infected increased from 3 percent to 16 percent during the 5-year period. During the evaluation 7.9 percent of the infected trees died. The disease originated more often in the leaders than lateral branches of young trees. Reduced diameter growth and increased rates of mortality were observed in infected trees. Trees not killed were often malformed.

Laird and Chellman (8) evaluated damage in a north Florida slash pine plantation (Union County) during 1970-72. They evaluated 80 - twenty-five tree plots - in a 200 acre, 11-year old plantation. Initial infection rates were high and symptoms were mainly in terminal branches and upper top whorls of the trees. They found infection rates increased from 34 percent to 44 percent in 2 years. Severely damaged trees (more than the top third dead) increased from 5 percent to 7 percent. Tree mortality increased from 1 percent to 5 percent. The authors concluded slash pine plantations severely infected with pitch canker were capable of recovery.

Schmidt and Underhill (9) also evaluated incidence and impact in north Florida slash pine plantations (Union and Flagler Counties) during 1969-71. They evaluated 16 plantations ages 11 and 19 years. Plot size was 100 trees in each plantation. Results indicated the rate of disease increase was 7.6 percent per year. Of the 139 diseased trees in 1969; 58.3 had recovered, 37.4 had not recovered, and 4.3 percent had died by 1970. Of the 213 diseased trees evaluated in 1970; 55.9 percent had recovered, 38.0 percent had not recovered, and 6.1 percent had died by 1971. Annual losses were estimated to be 0.23 cords/acre due to growth loss in infected trees and 0.15 cords/acre due to mortality or a total of 5.28 cords/acre over a 25 year rotation.

Renewed interest for "pitch canker" occurred during 1969-70 when there was a localized outbreak in slash pine plantations in Union and Flagler counties. However, it was not until 1974-75 that extreme concern was expressed by forest land managers when severe outbreaks, with tree mortality, occurred on industrial lands



in Flagler, Volusia and Putnam counties. During March and April 1976, a cooperative U.S. Forest Service - Florida Division of Forestry evaluation was implemented in slash pine plantations and seed orchards to achieve the following objectives:

- 1) to determine the incidence and severity of the disease in slash pine plantations and seed orchards.
- 2) to develop a "pitch canker" incidence map of Florida.
- 3) to determine the current wood fiber and financial loss due to the disease in plantations, and
- 4) to determine the long range effects and financial loss in slash pine plantations of known severity classes.

#### METHODS

The plantation evaluation was conducted using the Yandle-Roth ratio estimation survey method (10). Training sessions in survey procedures and data collection were conducted by State and Private and Florida Division of Forestry personnel. The Florida Division of Forestry districts and counties evaluated were:

- District 1 - Escambia, Santa Rosa, Okaloosa
- District 2 - Holmes, Washington, Walton, Jackson
- District 3 - Bay, Gulf, Calhoun, Liberty, Franklin
- District 4 - Gadsden, Wakulla, Leon, Jefferson
- District 5 - Taylor, Lafayette, Dixie, Madison
- District 6 - Hamilton, Suwannee, Columbia, Baker
- District 7 - Duval, Clay, Nassau
- District 8 - Alachua, Putnam, Bradford, Union
- District 9 - Marion, Levy, Gilchrist
- District 10 - Flagler, St. Johns, Volusia
- District 11 - Citrus, Hernando, Lake, Pasco, Sumter
- District 12 - Osceola, Orange, Seminole, Brevard
- District 14 - Hillsborough, Pinellas, Polk
- District 15 - Hardee, Manatee, Sarasota, DeSoto, Charlotte
- District 16 - Okeechobee, Highlands, Glades, Martin, St. Lucie,  
Indian River
- District 17 - Collier, Hendry, Lee
- District 18 - Dade, Broward, Palm Beach, Monroe

An evaluation was made in each county where north Florida slash pine were planted. Seven plantations were chosen at random in the age classes 5 to 7, 8 to 10, 11 to 13, 14 to 16, 17 to 19, 20 to 22, and 23 years or older; planted in the years 1969 to 71, 1966 to 68, 1963 to 65, 1960 to 62, 1957 to 59, 1954 to 56, and 1953 or older, respectively. These age classes were later combined for summarization into age categories 5 to 10 years, 11 to 15 years, 16 to 22 years, and 23 to 28 years. There was not enough plantations older than 28 years to have a representative sample. A minimum of 7 plantations were to be evaluated in each county. In some southern counties it was not possible to obtain the required number of

north Florida slash plantations in each age class and no plantations were found in Palm Beach, Broward, Dade, Martin, Hendry, and Collier counties. It had been determined that "pitch canker" was randomly distributed throughout plantations (9) therefore, the ratio-estimation statistical sampling method was used in the survey. This method was simple, rapid, and easily applied by individuals having a minimum of training in the procedure. Since an acceptable estimate of disease severity for an individual plantation or stand could be obtained, the procedure was adapted for use in the statewide evaluation. Data was transposed onto a map showing county incidence percent. Impact information was developed by obtaining diameter and height measurements on 30 healthy and 30 infected trees in each plantation. Volume tables used were those presented by Bennett et.al. (1) and Goddard et.al. (5). Additional tree stand and weather data were obtained to determine their correlations with disease severity.

Data were taken on the first 250 trees and planting spaces in 3 rows selected at random in each plantation. Individual pitch canker infection tree data was recorded as follows: 0 - missing; 1 - healthy; 2 - 1-3 lateral branch tips with dieback only; 3 - terminal dieback only; 4 - terminal dieback, 1-3 lateral branch tips with dieback; 5 - terminal dieback, less than half crown with dieback; 6 - terminal dieback, more than half crown with dieback; 7 - dead from dieback; 8 - dead from other causes. Percent infection and a county severity index was calculated from the above numerical ratings. A rating scale of 1 to 7 was used to calculate the severity index; the higher the number, the more severe the disease incidence.

Data was collected by the Florida Division of Forestry field personnel. After recording, it was computer summarized by Dr. David O. Yandle, Duke University biometrician. Diseased specimens were collected in sampled plantations throughout the State for laboratory culture and fungus identification.

#### SEED ORCHARDS

A 100 percent tree evaluation was made in 25 slash pine and seed orchards of the University of Florida Tree Improvement Cooperative. Seed orchards evaluated were as follows:

<u>Organization</u>	<u>County</u>
St. Regis Paper	Madison, Escambia
Gilman Paper	Madison, Lafayette
Owens Illinois	Hamilton
Container Corporation	Nassau, Bradford
ITT - Rayonier	Nassau
Hudson Paper	Putnam
University of Florida	Alachua
Buckeye Cellulose	Taylor
International Paper	Jackson
Florida Division of Forestry	Santa Rosa, Hernando



Data were taken on all clones planted in the orchard. The pitch canker infection tree code categories were: 0 - missing; 1 - healthy; 2 - 1-3 lateral branch tips with dieback only; 3 - terminal dieback only; 4 - terminal dieback, 1-3 lateral branch tips with dieback; 5 - terminal dieback, less than half crown with dieback; 6 - terminal dieback, more than half crown with dieback; 7 - dead from dieback; 8 - dead from other causes; 9 - fusiform rust canker.

Training sessions in evaluation procedures and data collection were conducted by State and Private and Florida Division of Forestry personnel. Data were collected by the seed orchard personnel. After recording, it was handled in the same manner as the plantation data. Suspect diseased specimens were collected in each seed orchard for laboratory culture and fungus identification.

## RESULTS

### Plantations

Approximately 3.4 million acres of slash pine were planted in Florida from 1928 to 1975. Most of these were planted during and after the soil bank program in the 1950's. A total of 398 north Florida slash pine plantations in the age range of 5 to 39 years in 60 counties were used in the sample. Counties with the highest infection rates and severity indices are found in Table 1. Photographs of disease signs and symptoms are found in Figures 1 to 8 in Appendix 1. The incidence and severity of the disease in each county evaluated is summarized in Appendix 2. Copies of the data sheets used in the survey are found in Appendix 4. A map showing disease incidence by counties is presented in Figure 1.

The disease now has been found in all 67 Florida counties and is widespread throughout the state where slash pine is growing. In this evaluation, it was found in 58 of the 60 counties surveyed. It was estimated that 1.1 million acres have some degree of infection. Disease incidence was especially serious in the central and southern counties. These were in order of disease severity: Volusia, Osceola, Sumter, Lee, Hillsborough, Flagler, and Glades. Other counties of significance were: St. Lucie, Hernando, Liberty, Marion, Franklin, Gadsden, Alachua, Seminole, Pasco, and Indian River. Since plantations were selected at random in each county, it would be possible to have individual plantations with higher infection rates than were indicated by the results. In a rapidly expanding outbreak, infection rates could considerably increase as the result of new infections. The results and incidence map were a general indication of incidence at the time this evaluation was made.

"Pitch canker" impact on slash pine is presented in Table 2. Statewide, very little infection occurred in trees less than 10 years. As the trees grew older, the infection rate increased 12 fold by the time they were 23 to 28 years old. In age class 5-10 years, there was 2 percent infection; 11-16 years, 5 percent; 17-22 years, 13 percent; and 23-28 years, 25 percent. In Volusia County, these infection rates were 5-10 years, 9 percent; 11-16 years, 14 percent; 17-22 years, 41 percent; 23-28 years, 67 percent. Mortality resulting from the disease was

TABLE 1. COUNTIES WITH HIGHEST "PITCH CANKER" INCIDENCE IN PLANTATIONS

COUNTY	AGE RANGE	INFECTION RANGE	SEVERITY INDEX
	(YEARS)	(PERCENT)	(NUMBER)
VOLUSIA	7-23	1-67	3.29
OSCEOLA	6-25	0-63	3.05
SUMTER	6-34	0-55	2.84
LEE	6-14	15-53	2.47
HILLSBOROUGH	5-28	0-45	2.47
FLAGLER	6-27	5-42	2.27
GLADES	5-15	0-39	2.05
ST. LUCIE	10	39	1.94
HERNANDO	6-36	0-21	1.70
LIBERTY	5-35	0-25	1.59
MARION	5-25	0-14	1.53
FRANKLIN	5-20	0-18	1.45
GADSDEN	5-25	0-5	1.45
ALACHUA	6-30	0-12	1.42
SEMINOLE	6-17	0-11	1.23
PASCO	7-23	0-6	1.23
INDIAN RIVER	6-16	5-11	1.20





less than 1 percent in all age classes, and 8.5 percent due to other causes. In several plantations with the infection rates above 50 percent dead trees resulting from "pitch canker" were 5 percent.

Growth data analysis of trees 17 years and older showed, on the average, healthy trees were 7.22 inches dbh and 50 feet in height, while diseased trees were 7.00 inches dbh and 46 feet in height; a difference of 0.22 inches in diameter and 4 feet in height. This was calculated to be 0.74 cu.ft./tree loss in wood fiber. On an average, if there was 545 trees/acre, 25 percent infection there would be a growth loss in wood fiber of 101 cu.ft. or 1.4 cords/acre. Wood loss from mortality due to "pitch canker" was negligible. In heavily infected plantations i.e., 60 percent there would be a growth loss of 242 cu.ft. or 3.2 cords/acre (1 cord equals 75 cu.ft.). Using a pulpwood stumpage value of \$22/cord there would be an average estimated loss of \$31/acre and \$70/acre, respectively. However, the potential wood fiber loss could be as high as 6.8 cords/acre or \$150/acre (Table 2).

Stand and weather data were analyzed to determine if there was any correlation with disease severity. Infection rates were highest and the disease most widespread in flat, sandy, wet and fertilized sites which had some type of fire in the stand at one time or another. Site preparation, previous land use and height of ground cover appeared to have no effect on infection rates. Temperature, rainfall, and humidity did not appear to affect infection rates to any considerable extent. For counties with high infection, Volusia and Flagler had an annual average rainfall of 45 inches, temperature 71 degrees and humidity 74 percent; Hillsborough had 62 inches, 81 degrees and 54 percent; Lee had 54 inches, 74 degrees and 75 percent. If the disease was prevalent, it caused infection in all age trees whether the annual rainfall, temperature or humidity was high or low.

Suspect diseased terminal, lateral branches and stem cankers were taken from symptomatic trees in plantations and seed orchards for laboratory culture and fungus identification. Approximately 300 samples were taken throughout the State. These were freshly collected from the field and immediately refrigerated. Collections were transported to the laboratory in ice chests so samples would be in fresh condition for culturing. Preliminary results indicate Fusarium lateritium f. pini is being isolated in a very low frequency compared to another Fusarium species. A separate report will be released summarizing these results in several months.

#### Seed Orchards

Table 3 shows the incidence and severity of dieback in slash pine seed orchards. Appendix 3 gives the clones with the highest disease incidence and severity. Dieback symptoms were evident in 22 of the 25 seed orchards evaluated in 12 counties. These symptoms were similar to the ones observed in plantations. Infected clones ranged from 4 to 68 percent in each orchard. The number of infected trees ranged from 0.3 to 18.3 percent. Severity indices ranged from 1.01 to 1.46. Incidence was low except in Madison and Taylor counties while severity



TABLE 3. INCIDENCE OF "PITCH CANKER" IN SLASH PINE SEED ORCHARDS

ORGANIZATION	COUNTY	CLONES (NUMBER)	PERCENT INFECTION		SEVERITY INDEX
			CLONES (PERCENT)	TREES (PERCENT)	
ST. REGIS	MADISON	254	43	18.3	1.46
BUCKEYE	TAYLOR	59	68	13.2	1.25
INTERNATIONAL	JACKSON	66	56	8.5	1.20
CONTAINER	NASSAU	131	42	8.2	1.11
ST. REGIS	ESCAMBIA	303	23	8.2	1.09
GILMAN	LAFAYETTE	87	30	4.2	1.06
HUDSON	PUTNAM	59	10	2.5	1.02
FLA. DIV. OF FORESTRY	SANTA ROSA	312	31	1.5	1.02
FLA. DIV. OF FORESTRY	HERNANDO	231	23	0.6	1.02
GILMAN	MADISON	78	4	0.3	1.02
CONTAINER	BRADFORD	83	7	0.3	1.01
UNIVERSITY OF FLORIDA	ALACHUA		(2 TREES PROBABLE)		
ITT-RAYONIER	NASSAU		NONE		
OWENS ILLINOIS	HAMILTON		NONE		

TABLE 4. INCIDENCE OF FUSIFORM RUST IN SLASH PINE SEED ORCHARDS

ORGANIZATION	COUNTY	CLONES (NUMBER)	PERCENT INFECTION	
			CLONES (PERCENT)	TREES (PERCENT)
GILMAN	MADISON	78	84	71.8
GILMAN	LAFAYETTE	87	41	20.5
ST. REGIS	MADISON	254	37	15.0
BUCKEYE	TAYLOR	59	83	14.5
INTERNATIONAL	JACKSON	66	42	2.7
ST. REGIS	ESCAMBIA	303	3	0.3
FLORIDA DIVISION OF FORESTRY	SANTA ROSA	312	5	0.1
FLORIDA DIVISION OF FORESTRY	HERNANDO	231	0	0.0
HUDSON	PUTNAM	59	0	0.0
CONTAINER	NASSAU	131	0	0.0
CONTAINER	BRADFORD	83	0	0.0



was low in all orchards. The data showed certain clones were more susceptible to attack than others. There were 1163 resistant and 500 susceptible clones in the evaluated orchards. There appeared to be a genetic interaction between the pathogen and host in various slash pine clones. Other diseases which were serious in several orchards were fusiform rust and cone rust. Insects observed included twig beetles, flower thrips, and bark beetles. Fusiform rust, ranging in severity from 0.1 to 72 percent of the trees was found in seed orchards in 7 counties. Orchards in 4 counties were free from infection. It was most serious in Madison, Lafayette and Taylor counties. Table 4 gives the rust incidence for all evaluated seed orchards.

### DISCUSSION

The spread and intensification of "pitch canker" throughout Florida and south Georgia during the past 23 years indicated the disease can spread and burst very rapidly into outbreak proportions. This was especially true in central Florida when it greatly intensified over the past 2 years. The disease is potentially a serious threat to slash pine plantings if the rate of spread and its explosive outbreak nature continues. Some observations made during the evaluation were 1) diseased trees occurred at random throughout the sampled plantations, 2) initial symptoms appeared mainly in the current years growth, and 3) overall mortality due to the disease was negligible. This agreed with the observations made in 1970 by Schmidt and Underhill (7). Ips bark beetle activity was noted in several of the plantations. Some trees had remnants of dead terminal branches and forked main stems indicating they had been infected previously, but had recovered from the fungus attack. Some of these trees were reinfected while others appeared to be completely healthy. A lateral branch had become dominant, replacing the dead terminal, and the tree continued to grow. Laird and Chellman (8) made similar observations in their Union County evaluation in 1972.

A recent evaluation made in April 1976, by the Georgia Forestry Commission in southern and southeastern counties of Georgia, showed "pitch canker" incidence to be moderate to low (4). In 56 counties evaluated, 20 counties located primarily in south Georgia reported "pitch canker" infection in plantations. Infection ranged from 1 to 19 percent with an average of less than 5 percent. A separate evaluation made on industry lands showed infection rates of 1 to 25 percent with an average of 11 percent. Brantley, Camden, Charlton, Clinch, Glynn and Wayne counties reported the highest amounts of disease infection.

The disease was locally serious especially in central and south Florida. It was apparent the north Florida slash variety elliottii was the preferred host. Disease incidence in the south Florida slash variety densa and in natural slash stands is considerably lower than disease incidence in variety elliottii plantations in central and south Florida (3). This indicates a site relationship could be involved or more probable a genetic interaction between the pathogen and host in various slash pine clones and varieties. This fact is further confirmed by the seed orchard evaluations. Certain slash clones were found to be heavily infected while others were free from infection. In addition, data from 21 outplanted slash clones in a field progeny test (Calhoun County) showed 19 infected and 2 resistant

in an infection range of 0 to 56 percent. The family showing the highest infection rate for "pitch canker" was one of the most resistant ones to fusiform rust. 1/ It should be possible to develop a resistance screening method for "pitch canker" to evaluate 1 to 2 year seedlings. When procedures are developed, State and Private Forestry's Disease Resistance Testing Center at Bent Creek, North Carolina could operationally test families for resistance.

Wood fiber loss resulting from the disease at this time is mainly growth reduction, diseased trees in general having less volume than healthy trees. Mortality occurring at the time of this evaluation was negligible; however, in heavily infected plantations 22 years or older there was some mortality occurring in trees with multiple branch and stem infections. These losses could amount to 6.8 cords/acre in the future. In order to determine the actual long range impact and financial loss, it will be necessary to establish permanent evaluation plots over stratified infection rates, i.e., 0 to 25 percent, 26 to 50 percent, 51 to 75 percent, 76 percent and higher. Annual data would be collected over a 5 year period. These plots should be established throughout the state this fall.

The urgency in this problem at the present is the need for research to be immediately initiated to furnish land managers information necessary to prevent or suppress this potentially serious forest tree disease. It will be necessary to determine, 1) the organism or organisms causing the disease, 2) sources of inoculum and means of dissemination to healthy trees, 3) the effect of host nutrition on disease incidence and development, 4) the effect of site cultural and environmental factors on disease incidence, 5) extent of pathogen variability and susceptibility of various pine species and slash pine families, 6) conditions necessary for localized serious outbreaks and 7) practical suppression strategies.

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1/ Personal communication with James Bailey, International Paper Company.



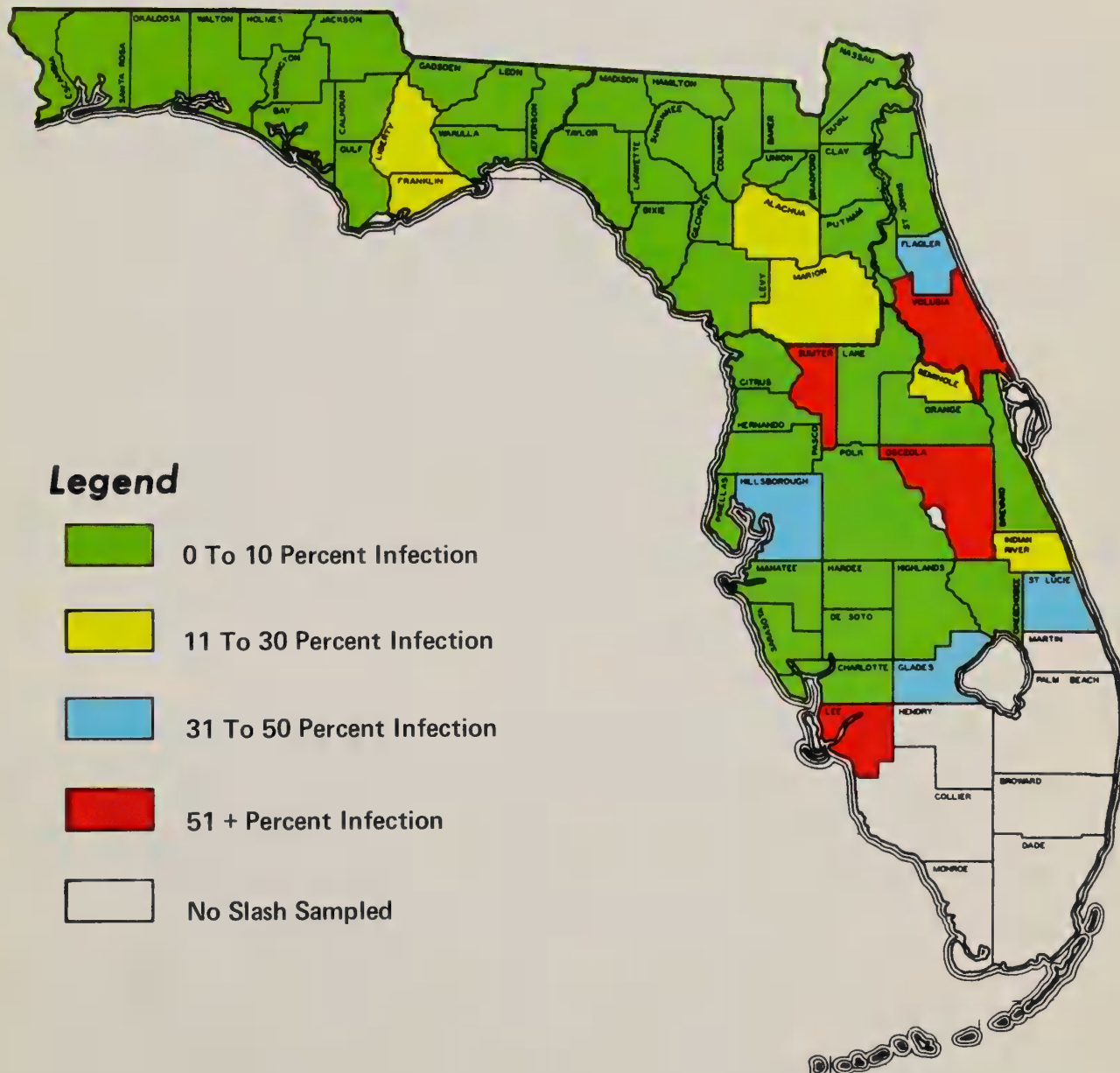
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# FLORIDA "PITCH CANKER" SURVEY - 1976



**Figure 1**





# APPENDIX I



*Figure 1 – Canker on trunk showing copious pitch flow*



*Figure 2 – Dead Terminal and lateral branches*



*Figure 3 – Flagging lateral branches*



*Figure 4 – Flagging tops in moderately infected plantation*







*Figure 5 — Susceptible seed orchard clone showing top flagging*



*Figure 6 — Mainstem showing pitch soaked wood*



*Figure 8 — Tree mortality caused by multiple branch and trunk infections*

*Figure 7 — Canker causing pitch soaking in terminal branch*





APPENDIX 2. INCIDENCE OF " PITCH CANKER" IN FLORIDA SLASH PINE PLANTATIONS

COUNTY	PLANTATIONS SAMPLED	AGE RANGE	INFECTION RANGE	SEVERITY INDEX
	(NUMBER)	(YEARS)	(PERCENT)	(NUMBER)
ALACHUA	7	6-30	0-12	1.42
BAKER	7	6-23	<1	1.02
BAY	7	5-25	0-5	1.09
BRADFORD	8	5-22	<1	1.03
BREVARD	1	17	2	1.06
CALHOUN	7	5-24	0-6	1.19
CHARLOTTE	7	9-17	0-2	1.09
CITRUS	7	5-29	0-5	1.11
CLAY	7	7-23	0-10	1.20
COLUMBIA	7	5-25	0-2	1.05
DESOTO	7	6-30	0-8	1.16
DIXIE	7	7-26	0-1	1.04
DUVAL	7	5-28	<1	1.01
ESCAMBIA	7	7-28	0-1	1.05
FLAGLER	7	6-27	5-42	2.27
FRANKLIN	8	5-20	0-18	1.45
GADSDEN	7	5-25	0-5	1.45
GILCHRIST	7	7-20	0-9	1.22
GLADES	4	5-15	0-39	2.05
GULF	7	5-20	0-5	1.20
HAMILTON	7	7-30	0-4	1.14
HARDEE	7	10-30	0	1.00
HIGHLANDS	4	6-30	0-4	1.04



APPENDIX 2. INCIDENCE OF " PITCH CANKER" IN FLORIDA SLASH PINE PLANTATIONS

COUNTY	PLANTATIONS SAMPLED	AGE RANGE	INFECTION RANGE	SEVERITY INDEX
	(NUMBER)	(YEARS)	(PERCENT)	(NUMBER)
HERNANDO	13	6-36	0-21	1.70
HILLSBOROUGH	7	5-28	0-45	2.47
HOLMES	7	6-19	<1	1.04
INDIAN RIVER	3	6-16	5-11	1.20
JACKSON	7	5-24	0-2	1.09
JEFFERSON	7	6-27	0-2	1.19
LAFAYETTE	7	6-23	0-5	1.13
LAKE	7	7-34	<1	1.01
LEE	5	6-14	15-53	2.47
LEON	7	7-28	<1	1.06
LEVY	7	8-25	0-4	1.09
LIBERTY	7	5-35	0-25	1.59
MADISON	7	6-36	0-1	1.10
MANATEE	7	6-29	<1	1.01
MARION	7	5-25	0-14	1.53
NASSAU	7	5-26	<1	1.02
OKALOOSA	7	7-30	<1	1.04
OKEECHOBEE	3	8-16	0-8	1.15
ORANGE	7	11-21	0-3	1.10
OSCEOLA	7	6-25	0-63	3.05
PASCO	7	7-23	0-6	1.23
PINELLAS	6	14-27	0	1.00
POLK	7	10-21	0-5	1.12



APPENDIX 2. INCIDENCE OF "PITCH CANKER" IN FLORIDA SLASH PINE PLANTATIONS

COUNTY	PLANTATIONS SAMPLED	AGE RANGE	INFECTION RANGE	SEVERITY INDEX
	(NUMBER)	(YEARS)	(PERCENT)	(NUMBER)
PUTNAM	7	7-29	0-2	1.06
SANTA ROSA	8	5-35	0-9	1.25
SARASOTA	6	8-39	0-4	1.09
SEMINOLE	7	6-17	0-11	1.23
ST. JOHNS	7	5-27	0-4	1.13
ST. LUCIE	1	10	39	1.94
SUMTER	7	6-33	0-55	2.84
SUWANNEE	7	5-25	0-2	1.09
UNION	7	5-23	0-7	1.42
VOLUSIA	7	7-23	1-67	3.29
WAKULLA	5	6-19	<1	1.03
WALTON	7	5-20	0-2	1.04
WASHINGTON	7	5-23	0-3	1.14
TAYLOR	7	6-24	<1	1.04

### APPENDIX 3. CLONES WITH HIGHEST INCIDENCE OF "PITCH CANKER"

<u>CLONE</u>	<u>TREES INFECTED</u> (PERCENT)	<u>SEVERITY INDEX</u> (NUMBER)
<u>BUCKEYE CELLULOSE (TAYLOR)</u>		
69-58	38	2.31
49	55	2.29
19-55	68	2.23
32-55	47	2.07
29-55	36	1.98
24	43	1.91
43	32	1.80
10-55	43	1.68
37-55	24	1.57
76-58	32	1.45
<u>CONTAINER CORPORATION (NASSAU)</u>		
37	31	2.00
112	33	1.78
169	22	1.78
176	33	1.76
47	32	1.73
351	29	1.71
167	50	1.67
39	26	1.61
108	36	1.57
2	22	1.47
<u>CONTAINER CORPORATION (BRADFORD)</u>		
244	25	1.25
37	2	1.08
203	6	1.06
151	1	1.06
110	4	1.04
96	1	1.03
ONLY 6 CLONES INFECTED		
<u>GILMAN (LAFAYETTE)</u>		
69	20	1.46
59-60	13	1.45
70-73	12	1.36
68	9	1.31
75-73	11	1.29
231-57	9	1.23
109	8	1.19
245-57	5	1.17
41-63	4	1.16
222-57	5	1.15

<u>CLONE</u>	<u>TREES INFECTED</u> (PERCENT)	<u>SEVERITY INDEX</u> (NUMBER)
--------------	------------------------------------	-----------------------------------

GILMAN (MADISON)

225-57	90	2.00
243-57	64	1.20
230-57	68	1.17

ONLY 3 CLONES INFECTED

FLORIDA DIVISION FORESTRY (SANTA ROSA)

1501	11	1.35
1204	8	1.34
909	11	1.33
310	10	1.29
1008	10	1.26
311	10	1.26
703	6	1.22
206	6	1.19
702	6	1.16
612	5	1.15

FLORIDA DIVISION FORESTRY (HERNANDO)

604	10	1.17
803	8	1.14
2	7	1.11
5	7	1.13
306	5	1.10
1204	5	1.09
1	3	1.06
310	4	1.06
320	4	1.06
325	4	1.05

HUDSON (PUTNAM)

198-55	44	1.44
235-56	11	1.37
231-56	9	1.36
230-56	6	1.13
237-56	7	1.07
234-56	6	1.07

ONLY 6 CLONES INFECTED



CLONETREES INFECTED  
(PERCENT)SEVERITY INDEX  
(NUMBER)INTERNATIONAL PAPER (JACKSON)

OK8	91	3.30
STA-5	89	2.78
STA19	45	2.10
FA2	40	2.09
CH30	63	2.00
FA4	60	2.00
G-5	40	1.59
S-50	29	1.57
SM-45	29	1.57
OK-15	28	1.53

ST. REGIS (MADISON)

CCA	80	3.40
C-3	65	3.37
C-32	64	2.71
JP-5	73	2.64
CW-7	29	2.60
R-5	60	2.58
RS-12	58	2.58
JP-3	78	2.52
D-12	52	2.26
C-17	49	2.26

SOME CLONES WITH LESS THAN 5 TREES HAD HIGHER VALUES

ST. REGIS (ESCAMBIA)

PDO-1	50	2.40
D-13	33	2.33
A-30	69	2.31
JP-5	60	2.20
D-9	57	2.00
A-37	45	2.00
CW-2	50	1.95
A-33	50	1.90
PDO-54	33	1.83
C-24	36	1.82
A-40	62	1.77
A-21	50	1.75

1951

Large (10000) ...  
... ..

# APPENDIX 4.

## Plot Data Work Sheet - Pitch Canker Plantation Survey, Florida: 1976

### Individual Tree Data

Location (State): \_\_\_\_\_ County: \_\_\_\_\_ Locality: S \_\_\_\_\_ T \_\_\_\_\_ R \_\_\_\_\_

Data by: \_\_\_\_\_ Date of Planting: \_\_\_\_\_ Row # \_\_\_\_\_ Page # \_\_\_\_\_

Species: \_\_\_\_\_ Age: \_\_\_\_\_ Site Index: \_\_\_\_\_ Spacing: \_\_\_\_\_

No. of rows

in stand: \_\_\_\_\_ Length of row: 1) \_\_\_\_\_ ft. 2) \_\_\_\_\_ ft. 3) \_\_\_\_\_ ft. Acres \_\_\_\_\_

Plant Space No.	Tree Code	Plant Space No.	Tree Code	Plant Space No.	Tree Code	Plant Space No.	Tree Code	Plant Space No.	Tree Code
1		26		51		76		101	
2		27		52		77		102	
3		28		53		78		103	
4		29		54		79		104	
5		30		55		80		105	
6		31		56		81		106	
7		32		57		82		107	
8		33		58		83		108	
9		34		59		84		109	
10		35		60		85		110	
11		36		61		86		111	
12		37		62		87		112	
13		38		63		88		113	
14		39		64		89		114	
15		40		65		90		115	
16		41		66		91		116	
17		42		67		92		117	
18		43		68		93		118	
19		44		69		94		119	
20		45		70		95		120	
21		46		71		96		121	
22		47		72		97		122	
23		48		73		98		123	
24		49		74		99		124	
25		50		75		100		125	

### Tree Code

0 = Missing tree

1 = Healthy tree

2 = 1-3 lateral branch tips with dieback only

3 = Terminal dieback only

4 = Terminal dieback, 1-3 lateral branch tips with dieback

5 = Terminal dieback, less than half crown with dieback

6 = Terminal dieback, more than half crown with dieback

7 = Dead from dieback

8 = Dead from other causes

9 = Fusiform rust canker



## INSTRUCTIONS

1. Tally all trees and spaces (missing trees) in each selected row; total trees should not exceed 250 in each row.
2. Use tree code number in space designated.
3. Row number is selected from random drawing of row number. Number of rows refers to total number of rows in stand. Length of row refers to rows actually surveyed.
4. Indicate information required on stand and weather data sheet. Be concise and accurate.
5. Measure tree height and diameter breast height (dbh) on 30 healthy and 30 infected trees in each plantation. Trees should be selected at random in each row examined.

## Data Work Sheet - Seed Orchard Survey, Florida: 1976

State: \_\_\_\_\_ County: \_\_\_\_\_ Locality(town): \_\_\_\_\_

Ownership: \_\_\_\_\_ Species: \_\_\_\_\_ Block # \_\_\_\_\_ Row # \_\_\_\_\_ Page# \_\_\_\_\_

[illegible]

## Tree Code

- |  |   |
|--|---|
| 1 = Healthy tree   | 5 = Terminal dieback, less than half crown with dieback |
| 2 = 1-3 lateral branch tips with dieback only              | 6 = Terminal dieback, more than half crown with dieback |
| 3 = Terminal dieback only                                  | 7 = Dead from dieback                                   |
| 4 = Terminal dieback, 1-3 lateral branch tips with dieback | 8 = Dead from other causes                              |
|  | 9 = Fusiform rust canker                                |







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